Boosting of data transmission

Field of the invention

This invention concerns a method of boosting data transmission in a telecommunications network.

Background of the invention

In Figure 1 of the appended drawing a simplified Global System for Mobile communications, a GSM system for short, is shown as a block diagram. The Network Subsystem, NSS, includes a mobile services switching centre MSC which is connected to other mobile services switching centres, and directly or through a Gateway Mobile Services Switching Centre, a GMSC system interface the mobile network is connected to other networks, such as a Public Switched Telephone Network, PSTN, an Integrated Services Digital Network, ISDN, other Public Land Mobile Networks, PLMN, and packet switched public data networks, PSPDN, and circuit switched public data networks, CSPDN. In the mobile services switching centre MSC there are Network Interworking Functions, IWF, for matching the GSM network with the other networks. Through an A-interface the NSS network subsystem is connected to a Base Station Subsystem, BSS, which includes base station controllers BSC, each one of which controls the base transceiver stations BTS connected to them. The interface between the base station controller BSC and the base transceiver stations BTS connected to it is an A bis interface. The base transceiver stations BTS for their part are connected over a radio path with mobile stations MS across the radio interface. The operation of the whole system is monitored by an Operation and Maintenance Centre, OMC.

The mobile station MS sends speech or user data across the radio interface on a radio channel at standard rates of e.g. 13 kbit/s or 5.6 kbit/s. Speech coding is used in the speech transmission to achieve a lower transmission rate than typically in telephone networks, whereby the band width needed by the radio link on the radio path is reduced. The base transceiver station BTS receives the data of the traffic channel and transmits it into the 64 kbit/s time slot of the PCM line. Into the same time slot, that is, channel, are also placed three other full-rate traffic channels of the same carrier wave, so the transmission rate per connection will be 16 kbit/s. For

half-rate traffic channels the transmission rate is 8 kbit/s per connection. A transcoder/rate adapting unit TRAU converts the coded 16 kbit/s or 8 kbit/s digital information to the 64 kbit/s channel, and on this channel the data is transmitted to an IWF unit which is located in the mobile services switching centre MSC and which performs the required modulation and rate conversion, whereupon the data is transmitted to some other network. Thus, the user data is transmitted over fixed connections in the uplink direction from base transceiver station BTS to base station controller BSC and to mobile services switching centre MSC and, correspondingly, the data to be relayed to mobile station MS is transmitted in the downlink direction from mobile services switching centre MSC through base station controller BSC to base transceiver station BTS and from there further over the radio path to mobile station MS.

In the GSM system, a Channel Codec Unit, CCU, of the base transceiver station performs a conversion of the signal received on the radio channel to the PCM time slot channel of the trunk line running over the A bis interface and a conversion of the frame structure of the signal received over the A bis interface into a form which can be transmitted on the radio channel. The transcoder unit TRAU performs the conversion operations on the signals to be transmitted across the A-interface. The transcoder/rate adapting unit TRAU is often located far from the base transceiver station, e.g. in connection with the base station controller BSC.

In a digital mobile system, speech is generally coded into a digital form by using low rate speech coding. Nowadays the SM system uses Full Rate FR coding at a transmission rate of 13 kbit/s, Half Rate HR coding at a transmission rate of 5.6 kbit/s, Enhanced Full Rate EFR coding at a transmission rate of 12.2 kbit/s and Enhanced Half Rate EHR coding. The enhanced speech codings are so advanced that the quality of speech is not significantly reduced in them.

Thus, speech coding is performed in the mobile station and on the mobile network side in the transcoder unit TRAU. The speech information to be transmitted is one of the parameters of the speech coding method. In modern GSM systems the TRAU transcoders are of several different types of coding, e.g. full rate, half rate or double acting, which is able to change from one rate to another. The transcoders convert the speech from a digital format into another, e.g. they convert 64 kbit/s A-law PCM arriving from the

exchange over the A interface into 13 kbit/s full rate FR coded speech for transmission to the base transceiver station line, and vice versa. In a call between two mobile stations PCM speech samples are transmitted from one transcoder to another, which codes them by a speech coding method which is used on the radio path. Repeated coding and decoding of the speech signal during the transmission will distort the speech signal, for which reason this coding-decoding chain, which is called tandem coding, is usually avoided.

The Finnish Patent Application FI-951807 presents transmission of speech frames, which have not been decoded, between transcoders and thus barring of tandem coding in the transcoder, when the call is one between two mobile stations, that is, a Mobile to Mobile Call, MMC. In the solution according to the application, the coded speech parameters are sent on the PCM time slot sub-channel without any decoding and coding in the TRAU transcoders of the mobile station network. Tandem coding is avoided by relaying with minor changes the frames coming from one base transceiver station BTS through these tandem connected TRAU transcoders to another base transceiver station BTS. The receiving transcoder will perceive from these minor changes in the frame that coding need not be done, and it will relay further the received speech parameters of the frame as such.

The Finnish Patent Application FI-960590 presents a transmission adaptation for a connection between exchanges. In the solution according to the application, a speech signal is transmitted coded by a speech coding method on a sub-channel of a PCM channel. The speech coding for the connection between exchanges is chosen according to the speech coding of the TRAU frames of the A-interface, except if the speech coding of the TRAU frames received from the A-interface is different from the speech coding of TRAU frames received from other transmission equipment, that is, if the parties to the call are using different speech codings. Figures 2a - 2c illustrate this adaptation of the transmission for a connection between exchanges in a few cases shown as examples. The speech coding used in each part of the transmission path is marked in the figures, in this example they are full rate FR and half rate HR speech coding. In Figure 2a both mobile stations MS1 and MS2 use the full rate FR speech coding method. Hereby the speech parameters are transmitted through the mobile station network as unchanged full rate speech parameters. In Figure 2b both mobile

stations MS1 and MS2 use a half rate HR speech coding method. Hereby the speech parameters are transmitted through the mobile station network as half rate speech parameters. In the case shown in Figure 2c, mobile station MS1 uses half rate HR speech coding while mobile station MS2 uses full rate FR speech coding. In this situation, a change is made at the mobile services switching centre MSC1 end to full rate speech coding and the necessary decoding and speech coding are performed.

A problem with the presented transmission situations is the need of transmission capacity, especially on the transmission connection between the base transceiver station and the network transcoder. The transmission in the mobile station network of speech parameters of the mobile station using full rate speech codec requires a full rate channel, which cannot be transmitted, if on the transmission connection e.g. only a half of that transmission capacity is available, which is required by a full rate signal.

Brief summary of the invention

The purpose of this invention is to boost data transmission especially in transmission connections on the network side of a mobile communications system.

This objective is achieved with the method and arrangement according to the invention, which are characterised by the features stated in the independent claims. Advantageous embodiments of the invention are presented in the dependent claims.

The invention is based on the idea that the data communications network uses at least in a part of the transmission path between a fixed station, e.g. a base transceiver station, and a transcoder unit a lower transmission rate speech coding than the transmission rate of the speech coding used on the transmission path between the fixed station and the terminal equipment. The speech parameters received from the terminal equipment are converted to the speech coding method used in the transmission connection between the fixed station and the transcoder unit, and vice versa. In the transcoder unit of the network it is possible to convert speech parameters received from the terminal equipment back to e.g. the speech parameters of the speech coding used on the transmission path between the terminal equipment and the fixed station.

It is an advantage of such boosting of data transmission that less

transmission capacity is needed per speech connection at least in a part of the transmission connection between the base transceiver station and the transcoder unit of the network.

It is another advantage of the data communications system according to the invention that it allows trafficking between terminal equipment using different speech coding methods, at best with only one speech coding during the transmission.

List of figures

The invention will now be described in greater detail in connection with advantageous embodiments and referring to the examples in accordance with Figures 3 - 6b in the appended drawings, wherein:

Figure 1 shows such parts of a mobile communications network which are essential to the invention;

Figures 2a-2c show examples of state-of-the-art speech transmission situations;

Figure 3 is a speech transmission diagram of data transmission boosting according to the invention;

Figures 4a and 4b show speech transmission situations according to a first embodiment of the invention as examples;

Figures 5a and 5b show speech transmission situations according to another embodiment of the invention as examples; and

Figures 6a and 6b show flow charts of data transmission boosting according to the invention.

Detailed description of the invention

The present invention may be applied in connection with any telecommunications system. The invention will be described hereinafter by way of example and mainly in connection with a digital GSM mobile communications system. Figure 1 shows the simplified structure of the GSM network described above. The interested reader will find background information as regards a more detailed description of the GSM system from GSM recommendations and from the book "The GSM System for mobile Communications", M. Mouly & M. Pautet, Palaiseau, France, 1992, ISBN:2-9507190-0-7.

Figure 3 shows boosting of data transmission in a mobile communications system in accordance with the invention. In the case shown as an example in Figure 3, the mobile station MS uses full rate speech coding. Hereby speech parameters of full rate FR speech coding are transmitted between base transceiver station BTS and mobile station MS. According to the invention, the speech parameters are converted for a transmission connection between base transceiver station BTS and the network transcoder unit TRAU into speech parameters of speech coding of a lower transmission rate, in the case shown in Figure 3 into speech parameters of half rate speech coding. Thus, the speech parameters received from the mobile station are decoded at the end of base transceiver station BTS and a new speech coding is carried out by a speech coding method of a lower transmission rate, in the case shown in Figure 3 by half rate speech coding. The new speech parameters thus obtained are transmitted over the transmission connection to the transcoder unit TRAU. Correspondingly, the speech parameters received from transcoder unit TRAU are decoded at the end of base transceiver station BTS and a new speech coding is performed by a speech coding method available on the radio path, in the case shown in Figure 3 by full rate speech coding. The resulting speech parameters are transmitted to mobile station MS over the radio path. When required, a corresponding conversion of the speech parameters is performed at the end of transcoder unit TRAU to transmit speech elsewhere in the network and from elsewhere in the network to the base transceiver station connection. From transcoder unit TRAU the speech is transmitted elsewhere in the network in some state-of-the-art manner. Instead of the speech codings shown in Figure 3 other speech codings may also be used, however, so that the speech coding in use in the connection between the base transceiver station and the transcoder unit is a speech coding of a lower transmission rate than the speech coding used on the radio path.

In the following the invention will be described in greater detail in the light of a first embodiment of the invention and referring to Figures 4a and 4b. In the first embodiment of the invention, a speech coder 45 according to the invention is located when required in connection with base transceiver station BTS to decode and recode the call to be relayed so that the speech parameters to be transmitted are converted between a first and a

second speech coding method. Figure 4a shows a call transmission connection between two mobile stations MS1 and MWS2 as an example. Mobile station MS1 uses enhanced full rate speech coding EFR and mobile station MS2 uses enhanced half rate speech coding EHR. Base transceiver station BTS1 receives the EFR speech parameters from mobile station MS1. The speech coder according to the invention decodes them and recodes by enhanced half rate speech coding EHR. These EHR speech parameters are transmitted through base station controller BSC1 to transcoder unit TRAU1 and from there further by using state-of-the-art barring of tandem coding as EHR speech parameters by way of exchanges MSC1 and MSC2 to transcoder unit TRAU2, which transmits the EHR speech parameters further through base station controller BSC2 to base transceiver station BTS2. At the end of base transceiver station BTS2 the EHR speech parameters are transmitted over the radio path to mobile station MS2, where enhanced half rate speech coding EHR is used. Thus, in the speech transmission described above, only one decoding and recoding of speech coding is performed on the mobile station network side. Correspondingly, the EHR speech parameters received from mobile station MS2 are transmitted unchanged over the transmission network to the end of base transceiver station BTS1, where a speech coder according to the invention decodes them and carries out recoding by enhanced full rate speech coding. These EFR speech parameters are transmitted from base transceiver station BTS1 over the radio path to mobile station MS1.

Figure 4b is an example of another situation showing a call transmission connection between two mobile stations MS1 and MS2 where both mobile stations MS1 and MS2 use enhanced full rate speech coding EFR. Base transceiver station BST1 receives the EFR speech parameters sent by mobile station MS1. In order to boost the data transmission on the connection between the base transceiver station and the network transcoder unit, the speech coder according to the invention decodes the speech parameters received at base transceiver station BTS1 and recodes the speech by enhanced half rate speech coding. The resulting EHR speech parameters are transmitted to transcoder unit TRAU1, which again transmits the EHR speech parameters unchanged through exchanges MSC1 and MSC2 to transcoder unit TRAU2. TRAU2 sends the EHR speech parameters to base transceiver station BTS2. Before being transmitted onto the radio

path, the received EHR speech parameters are decoded in a speech coder according to the invention and they are recoded by the enhanced full rate speech coding available on the radio path. The EFR parameters are transmitted to mobile station MS2. Correspondingly, the same procedure is used for the EFR speech parameters of mobile station MS2 which are received at base transceiver station BTS2.

Figures 5a and 5b show examples of situations in accordance with another embodiment of the invention. In this second embodiment of the invention a first speech coder 45 is located in connection with the base transceiver station, besides which another speech coder 55 is located in connection with transcoder TRAU also to decode and recode the speech to be relayed so that the speech parameters are converted between a first and a second speech coding method. Figure 5a shows a speech transmission connection between two mobile stations MS1 and MS2, when both mobile stations use enhanced full rate speech coding. The EFR speech parameters received by base transceiver station BTS1 from mobile station MS1 are converted in accordance with the invention into EHR parameters and they are transmitted to transcoder unit TRAU1 in the same manner as was described above in connection with the first embodiment of the invention. The EHR speech parameters received in transcoder unit TRAU1 are converted in a speech coder in accordance with the invention for a transmission rate of enhanced full rate speech coding. When required, the speech parameters may also be converted into PCM samples. At the transmission rate of enhanced full rate speech coding the speech is transmitted from transcoder unit TRAU1 through exchanges MSC1 and MSC2 to transcoder unit TRAU2. The speech received in transcoder unit TRAU2 is converted in a speech coder according to the invention back to EHR speech parameters, which are transmitted to base transceiver station BTS2. Before being transmitted onto the radio path, the EHR speech parameters are converted in accordance with the invention into EFR speech parameters, as was described above in connection with a first embodiment of the invention.

Figure 5b shows an example of another situation where mobile station MS1 uses enhanced full rate speech coding EFR and mobile station MS2 uses enhanced half rate speech coding EHR. The EFR speech parameters received at base transceiver station BTS1 are converted in

accordance with the invention into EHR speech parameters and they are transmitted to transcoder unit TRAU1 in the same manner as was presented above in connection with the description of Figure 4a. The EHR speech parameters received in transcoder unit TRAU1 are converted in a speech coder according to the invention into a transmission rate of enhanced full rate speech coding. When required, the speech parameters may also be converted into PCM samples. At the transmission rate of enhanced full rate speech coding the speech is transmitted from transcoder unit TRAU1 through exchanges MSC1 and MSC2 to transcoder unit TRAU2. The speech received in transcoder unit TRAU2 is again converted in a speech coder according to the invention into EHR speech parameters, which are transmitted to base transceiver station BTS2 and from there further over the radio path to mobile station MS2. The EHR speech parameters received from mobile station MS2 are converted correspondingly in a reversed order when transmitting the speech in the network from base transceiver station BTS2 to base transceiver station BTS1.

Figure 6a shows boosting of data transmission in accordance with the invention in a mobile communications system in the uplink direction. At point 602 the transmission rate is determined which is to be used on the transmission path between the base transceiver station and the transcoder unit, and at point 604 the transmission rate of speech parameters received from mobile station MS at the base transceiver station is determined, that is, the transmission rate used on the radio path. At point 606 the transmission rates determined above are compared with one another. If the radio path transmission rate is higher than the transmission rate of the transmission path between the base transceiver station and the transcoder unit, the speech parameters are decoded (point 608) and they are recoded by the second speech coding, which is used on the transmission path between the base transceiver station and the transcoder unit (point 610). The speech parameters thus processed are transmitted from the base transceiver station to the transcoder unit over the transmission path (point 612). If in the check at point 606 the radio path transmission rate is not higher than the transmission rate of the transmission path, then the speech parameters are processed in a state-of-the-art manner and they are transmitted further in the network.

Figure 6b shows boosting of data transmission in accordance with

the invention in a mobile communications system in the downlink direction. At point 622 the transmission rate used on the radio path is determined, while at point 624 the transmission rate of speech parameters received from the transcoder unit at the base transceiver station are determined. At point 626 a comparison is made between the transmission rates determined above. If the transmission rate used on the transmission path between the base transceiver station and the transcoder unit is lower than the transmission rate of the radio path, then the received speech parameters are decoded (point 628) and they are recoded by a first speech coding, which is used on the radio path (point 630). The reprocessed speech parameters are transmitted from the base transceiver station to the mobile station over the radio path (point 632). If it is found in the check at point 626 that the transmission rate of the transmission path is not lower than the transmission rate of the radio path, then the speech parameters are transmitted to the mobile station in a state-of-the-art manner.

The speech coder in accordance with the invention supports two or more speech coding methods, which are used in a telecommunications system, preferably in a mobile communications system. The speech coder according to the invention may also be used in other situations than those shown in the preceding examples to implement the functionality according to the invention.

In mobile station MS speech coding and decoding are performed in a state-of-the-art manner, which is why it is not described in greater detail in this connection.

The drawings and the related explanation are intended only to illustrate the inventive idea. As regards its details the boosting of data transmission in accordance with the invention may vary within the scope of the claims. Even though the invention was described above mainly in connection with a mobile communications system, the boosting of data transmission may be used also for a telecommunications system of some other kind, when the telecommunications system uses a low transmission rate speech coding on the transmission path between the fixed station and the terminal equipment. Thus, in the present application a base transceiver station means any such unit in a telecommunications network which is in connection with pieces of terminal equipment, whereas a mobile station means both mobile and fixed pieces of terminal equipment which are in

connection with a telecommunications network. The functionality according to the invention may be implemented in the network for all connections or for some connections only.